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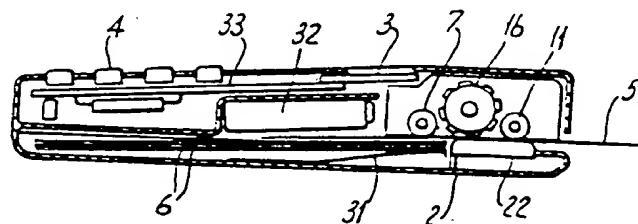
J. Miller & Co.

(54) Electronic calculator with printer

(57) An electronic calculator has a casing (1) within which is disposed electronic calculating circuitry (33) and a printer for printing results of calculations performed by the

calculating circuitry. The printer has a character ring (16) on the periphery of which there are print characters, and a paper feed roller (7) for feeding sequentially sheets of paper (5) from a stack (6) thereof, located within the casing, to the character ring.

Fig. 3.



The drawings originally filed
were informal and the print
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Fig. 1.

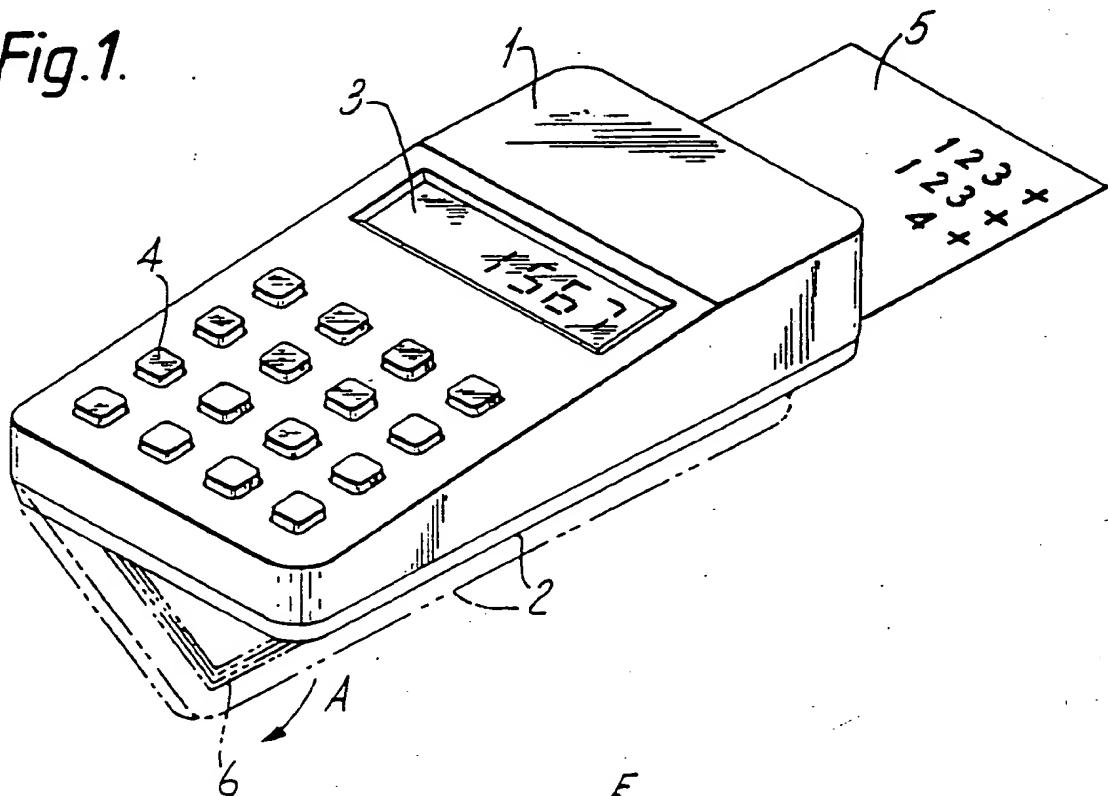
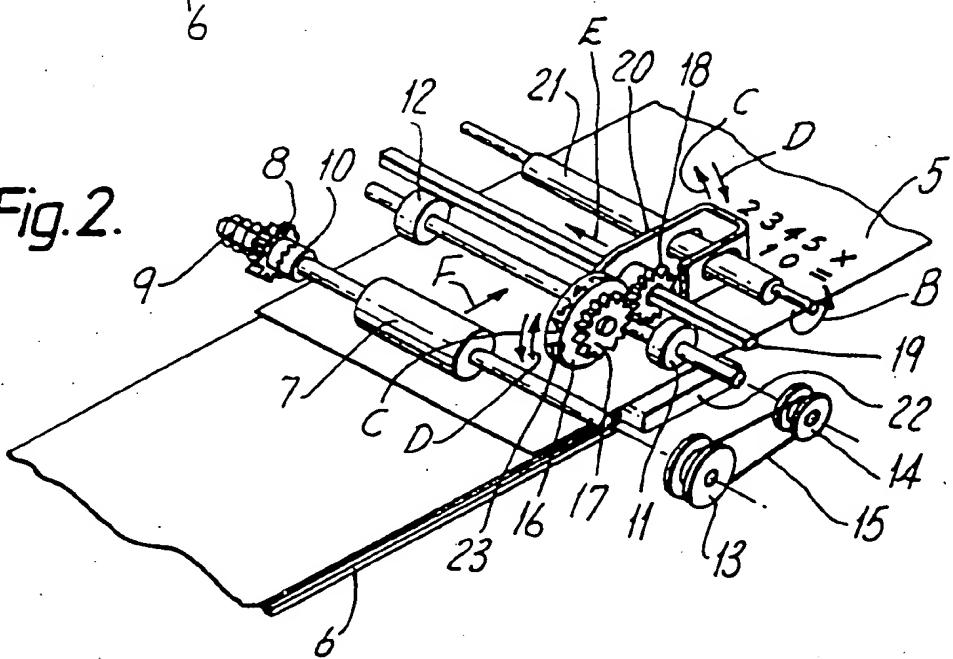


Fig. 2.



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Fig. 3.

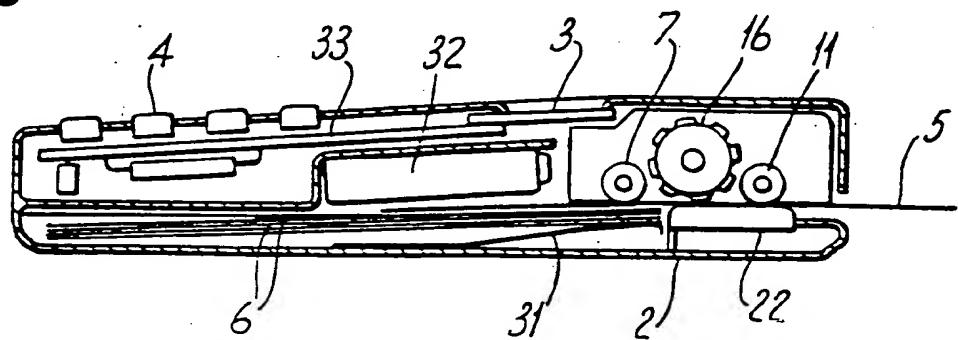


Fig. 4.

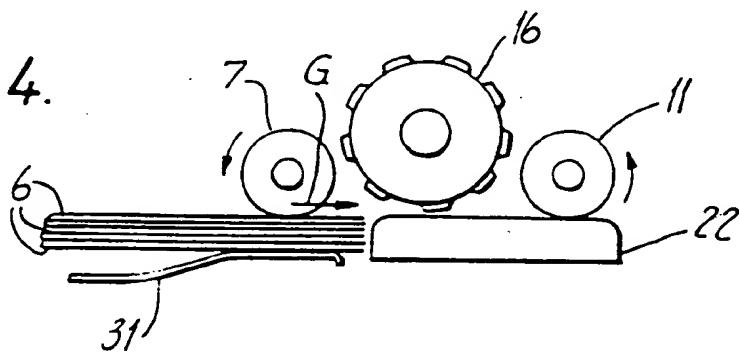
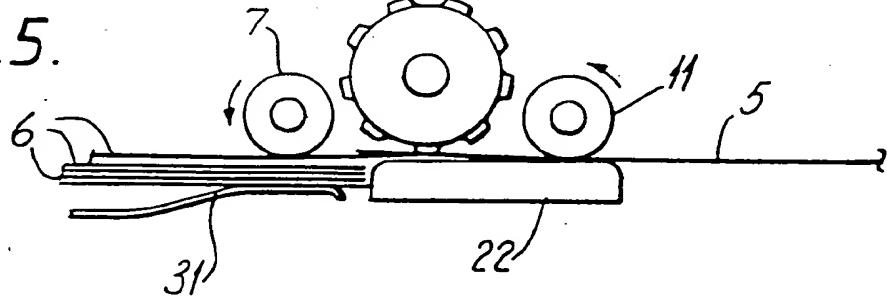


Fig. 5.



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Fig. 6.

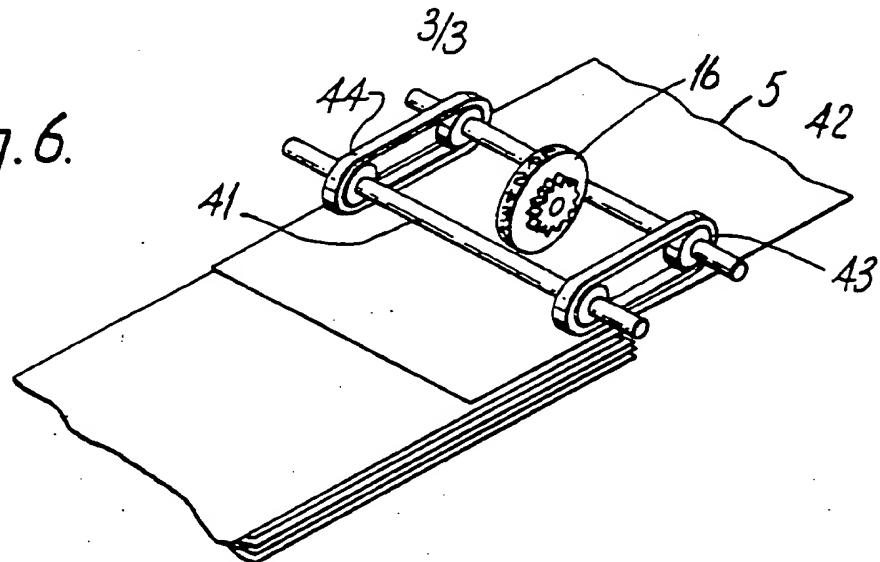


Fig. 7.

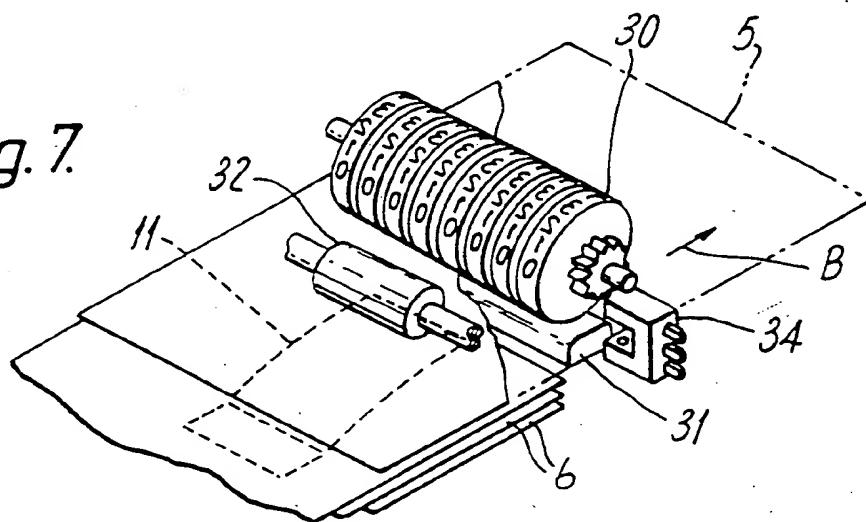


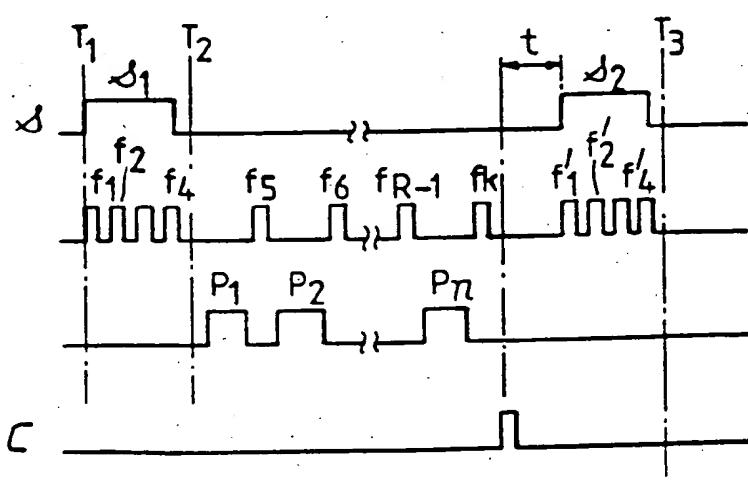
Fig. 8.

OUTPUT SIGNAL FROM
PHOTORESISTOR

PAPER FEEDING
OPERATION

PRINTING OPERATION

PAPER EXCHANGE
SIGNAL



SPECIFICATION
Electronic calculator

This invention relates to electronic calculators and in particular, although not so restricted, to electronic calculators with small size printers or so-called micro-printers.

Recently, electronic calculators have been miniaturised to a remarkable degree as a result of the use of LSI circuitry having a relatively low power consumption, the reduced thickness and low power consumption of liquid crystal display devices, the reduced thickness of batteries, and the simplification of keyboards. It is, however, difficult to miniaturise printers because although the printer itself can be miniaturised to a considerable extent, one cannot miniaturise the paper rolls conventionally used and on which printing is formed. A paper roll type printer is unsuitable, therefore, for use in an electronic calculator.

According to the present invention there is provided an electronic calculator having a casing within which is disposed electronic calculating circuitry and a printer for printing results of calculations performed by the calculating circuitry, the printer having printing means and paper feeding means for feeding sequentially sheets of paper from a stack of sheets of paper, located within the casing, to the printing means.

In one embodiment a paper feed means includes paper feed rollers upstream and downstream of the printing means. The paper feed roller or rollers downstream of the printing means may be arranged to feed paper at a faster rate than the paper feed roller or rollers upstream of the printing means.

Alternatively said paper feed means comprises at least one endless belt extending from upstream to downstream of the printing means and arranged to contact a sheet of paper in a printing position beneath the printing means.

In one embodiment the printing means comprises a print character ring and means for moving the print character ring transversely to the direction of feeding of the sheets of paper to form a line of printing. In another embodiment the printing means comprises a plurality of print character rings arranged side-by-side to form a line of printing.

The calculator may include detecting means for detecting the presence or absence of a sheet of paper in a printing position beneath the printing means. The calculator may include means for causing the paper feed means to feed a sheet of paper to the printing position when the absence of a sheet of paper in the printing position is detected by the detecting means.

The detecting means may be a photoelectric device.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:

Figure 1 is a perspective view of an electronic calculator according to the present invention;

65 Figure 2 is a schematic perspective view of one embodiment of a printer of the electronic calculator of Figure 1;

Figures 3 to 5 are side views illustrating the operation of the printer of Figure 2;

70 Figure 6 is a schematic view of part of another embodiment of a printer of the electronic calculator of Figure 1;

Figure 7 is a view similar to Figure 2 of part of a yet further embodiment of a printer of the electronic calculator of Figure 1; and

75 Figure 8 is a timing chart illustrating the operation of the printer of Figure 7.

Throughout the drawings like parts have been designated by the same reference numerals.

80 Referring first to Figure 1 there is illustrated an electronic calculator according to the present invention. The electronic calculator has a casing 1, a back cover 2 which can be opened and closed as indicated by an arrow A, a display device 3 such as a liquid crystal display device and a keyboard 4.

85 A sheet 5 of paper is printed by a micro or small size printer disposed within the casing 1, the sheet of paper being fed from the casing 1 by a paper feed mechanism. A stack 6 of sheets of paper, as

90 shown in Figure 2, are loaded into a rear space of the electronic calculator by opening the back cover 2. As seen in Figure 1, the use of a stack of sheets of paper makes the electronic calculator much easier to handle compared to an electronic calculator using a paper roll.

95 Figure 2 illustrates one embodiment of the printer. The printer has a paper feed mechanism consisting of a first paper feed roller 7, a drive gear 8 being arranged to rotate the paper feed roller

100 intermittently. A clutch coupling 10 is operated by a spring 9. The paper feed mechanism has second paper feed rollers 11, 12 mounted on the same shaft. The first paper feed roller 7 and the second paper feed rollers 11, 12 are drivingly linked by

105 pulleys 13, 14 around which passes a drive belt 15. A character ring 16 has print characters 23 on its periphery and a gear 17 on a side face. A gear which is rotated with a deformed or cranked shaft 19 engages the gear 17 to rotate the character

110 ring 16. The character ring 16 and the gear 18 are received in a frame 20. The frame 20 pivots in the direction of arrows C, D about the shaft 19 when an eccentric shaft 21 is rotated in the direction of an arrow B. When the frame 20 pivots in the

115 direction of arrow C the character ring 16 presses the sheet of paper against a platen 22 to perform a printing operation.

The operation of the printer shown in Figure 2

is as follows. The shaft 19 rotates the character ring 16 and a detector (not shown) detects character position signals corresponding to the

print characters 23 on the periphery of the character ring 16. When the character position signal coincides with a desired print character

120 determined by electronic calculating circuitry of the electronic timepiece, the frame 20 pivots to print the desired character by operating a one-turn clutch (not shown) provided on the shaft 21. Thus one column is printed. Other columns are printed

In the same manner by moving the frame 20 stepwise in the direction of an arrow E which is transverse to a direction F of feeding of the sheet of paper by the paper feed mechanism. A line of printing is completed when all columns have been printed. Next, the paper feed rollers 7, 11, 12 are rotated to feed the sheet 5 of paper in the direction of arrow F by one step ready for the next line of printing.

One feature of this printer is that the paper feed roller 7 is provided upstream of the character ring 16 and the paper feed rollers 11, 12 are provided downstream of the character ring 16. (The terms "upstream" and "downstream" are relative to the direction F). The continuous feed of the sheets of paper from the stack 6 thereof is thus possible. This will be described in greater detail with reference to Figures 3, 4 and 5.

In Figure 3, a battery 32 and a circuit board 33 on which is mounted the electronic calculating circuitry consisting of LSI and other electronic elements, are shown. A plate or leaf spring 31 attached to the back cover 2 urges the stack 6 of sheets of paper against the paper feed roller 7.

Figure 4 shows the state where the stack 6 of sheets of paper have just been loaded into the electronic calculator. The uppermost sheet of paper is pressed against the paper feed roller 7 by the plate spring 31 and is fed in the direction of arrow G upon rotation of the paper feed roller 7. A printing operation may be performed when the sheet of paper has passed a printing position beneath the character ring 16. Figure 3 shows the state where the sheet of paper is being fed from the electronic calculator. The sheet of paper, at the printing position, is always stretched by arranging the paper feed rollers 11, 12 to feed the sheet of paper faster than the paper feed roller 7. Figure 5 shows the state where the next sheet of paper begins to be fed from the stack 6 as the first sheet of paper is fed from the electronic calculator. When the first sheet of paper leaves the paper feed roller 7, the second sheet of paper engages with the paper feed roller 7 and begins to be fed. The first sheet of paper is fed by the paper feed rollers 11, 12 until the first sheet of paper is out of engagement with them. Thus the sheets of paper are fed from the stack sequentially through the printing position. In the case where printing is finished in the middle of a sheet 5 of paper, the coupling 10 on the shaft of the paper feed roller 7 is disengaged from the drive gear 8 by pulling the sheet of paper so that it may be removed easily from the calculator.

Figure 6 shows another embodiment of a printer for the electronic calculator of Figure 1. A paper feed roller shaft 41 upstream of the printing position and a paper feed roller shaft 42 downstream of the printing position are linked by endless drive belts 43, 44. The belts 43, 44 abut on the sheet of paper upstream and downstream of the printing position to feed the sheet of paper.

Referring now to Figure 7 there is shown a yet further embodiment of a printer of the electronic calculator of Figure 1, having a plurality of print

character rings 30 disposed side-by-side, one character ring being provided for each column to be printed. Desired print characters on the respective character rings 30 are selected and brought to a printing position by selecting electromagnetic mechanism (not shown). A platen 31 is pressed against the desired print characters during a printing operation to print on the sheet of paper. Then the sheet 5 of paper is fed by actuating a paper feed roller 32 to complete a printing operation.

The paper feed roller 32 is controlled by a signal from a photosensor 34 which detects the presence of a sheet of paper in the printing position beneath the character rings. The load on the paper feed mechanism including the paper feed roller 36 is considerably reduced as a result of the use of sheets of paper and the paper feed mechanism is simplified since the stack 6 of sheets of paper is pressed against the paper feed roller 32 by a plate spring such as the plate spring 31 shown in Figure 3.

Figure 8 is a timing chart of the operation of the printer of Figure 7. Since the beam of light falling on the photosensor 34 is not blocked when a stack of sheets of paper is merely loaded in the electronic calculator, a signal s_1 indicating the absence of a sheet of paper in the printing position is produced. The printer is programmed so that the paper feed roller 32 is operated while the signal s_1 is produced so that the sheet of paper 5 is fed by the paper feed roller 32 until the beam of light falling on the photosensor 34 is blocked thereby when the paper feed roller is stopped. That is, paper feed operations f_1 to f_4 are effected while the signal s_1 is produced between time T_1 and T_2 . At time T_2 a printing operation may be performed, printing operations being indicated in Figure 4 by P_1, P_2, \dots, P_n . After each printing operation a respective paper feed operation, indicated in Figure 4 by f_5 to f_k are performed. The number of paper feed operations for each sheet of paper depends on the length of the sheet of paper and the pitch of the paper feed operation and so a signal c is produced just before the end of the sheet of paper 5. The signal c inhibits further printing operations and, at the same time, gives an indication that another sheet of paper is required. The first sheet 5 of paper is removed when the signal c is produced and after a time t a signal s_2 indicating the absence of a sheet of paper in the printing position is produced from the photosensor 34 and the paper feed operation indicated by f'_1 to f'_4 for the next sheet of paper are produced. At time T_3 the printer is ready to begin further printing operations. Thus when a stack of sheets of paper are loaded in the electronic calculator a printing stand-by state is obtained at all times by virtue of the signal from the photosensor 34 and the paper feeding operations in accordance with the programme.

The printers according to the present invention feed the sheets of paper from the stack so that they operate like a printer with a continuous paper roll. Since the mass and inertia of the sheets of

paper is smaller than the inertia of a paper roll the load during paper feeding is reduced considerably and there are no great changes in load during operation. Therefore, the printer may be made 5 compact and so it is suitable for incorporation, for example, in an electronic calculator.

The above invention has been described in relation to a serial printer having one or more character rings but it is not limited thereto and the 10 invention may be applied to a parallel printer having a character drum or character ring or to a mechanical or thermal dot printer.

CLAIMS

1. An electronic calculator having a casing 15 within which is disposed electronic calculating circuitry and a printer for printing results of calculations performed by the calculating circuitry, the printer having printing means and paper feeding means for feeding sequentially sheets of 20 paper from a stack of sheets of paper, located within the casing, to the printing means.
2. A calculator as claimed in claim 1 in which the paper feed means includes paper feed rollers upstream and downstream of the printing means.
- 25 3. A calculator as claimed in claim 2 in which the paper feed roller or rollers downstream of the printing means are arranged to feed paper at a faster rate than the paper feed roller or rollers upstream of the printing means.
- 30 4. A calculator as claimed in claim 1 in which said paper feed means comprises at least one endless belt extending from upstream to downstream of the printing means and arranged to contact a sheet of paper in a printing position beneath the printing means.
- 35 5. A calculator as claimed in any preceding

claim in which the printing means comprises a print character ring and means for moving the print character ring transversely to the direction of feeding of the sheets of paper to form a line of printing.

- 40 6. A calculator as claimed in any of claims 1 to 4 in which the printing means comprises a plurality of print character rings arranged side-by-side to form a line of printing.
- 45 7. A calculator as claimed in any preceding claim including detecting means for detecting the presence or absence of a sheet of paper in a printing position beneath the printing means.
8. A calculator as claimed in claim 7 including 50 means for causing the paper feed means to feed a sheet of paper to the printing position when the absence of a sheet of paper in the printing position is detected by the detecting means.
9. A calculator as claimed in claim 7 or 8 in 55 which the detecting means is a photoelectric device.
10. An electronic calculator substantially as herein described with reference to and as shown in the accompanying drawings.
- 60 11. A microprinter to print calculating results on a slip paper comprising paper feeding means for continuously supplying said slip paper from a bundle of slip papers.
- 65 12. A microprinter to print calculating results on a slip paper comprising friction means for supplying slip papers disposed opposite to a bundle of slip papers and detection means for detecting existence of said slip paper at a printing position, in response to signal produced from said detection means said friction means for supplying slip papers being controlled to continuously supply said slip papers.
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